THE CUTANEOUS INNERVATION OF HUMAN NEWBORN PREPUCE*

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The study of cutaneous innervation has passed through several phases. The earliest period was marked by the description of numerous discrete structures, together with detailed and elaborate representation of these bodies. Great stress was placed on the ways in which these endings were to be distinguished from one another. The second period began with the more or less unitarian idea of Stöhr (1927) that the salient feature of these sensory endings was not their conformation, but rather the surface enlargement of nervous tissue which they provided. He believed that all afferent endings were expressions of a basic idea of stimulus reception, and that the various forms served as examples of specific structural development in the broad range of simple to more complex endings. His thoughts were well supported for transition forms between all the separate bodies had been described from the time of Wilhelm Krause. The most recent era began with the introduction of the methylene blue method in the study of cutaneous innervation by Woollard, and the use of it in such a manner by him and by Weddell that photomicrographs might be taken. They were able to correlate physiologic findings with histologic work as a routine experience. The intravital methylene blue method has its limitations, and recently by means of new silver impregnation methods Weddell and his group (Weddell and Zander 1950; Sinclair *et al*, 1952; Hagen *et al*, 1953) and the author (Winkelmann, 1955 a and b) have been able to confirm and extend the findings in various cutaneous areas and to delineate the sensory bodies that are present.

The prepuce was chosen for this present work because of its natural advantages. It is free from hair at its distal end, it is frequently available, and it is a region of great sensitivity and possessed of an abundant nerve supply. It is on the basis of studies of prepuce that much of the present correlation between specific sensory structure and specific function rests (Rothman, 1954).

The data available on the innervation of the prepuce is limited. While many articles have been written on the other regions of the external genitalia little has been said about this structure. Kantner (1953) reviewed the literature on genital innervation, and it is quite apparent from his discussion and the original papers that there continues to be much confusion about the sensory innervation of this area. The general review articles which covered the early descriptive work and from which the major portion of textbook discussions are taken say little about the genital area and nothing about prepuce specifically (Dogiel, 1903; Ruffini, 1905; Botezat, 1912; Stöhr, 1927; Pincus, 1927; and Boeke, 1932).

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Ohmori (1924) stated that all that is true for the glans penis is true for the prepuce. Under such circumstances the work of Krause and his pupils on the genital body and the outer genitalia (Krause, 1866; Bense, 1866; Finger, 1868) and all succeeding work could be taken as a basis for discussion of the present findings.

Probably the first reference to innervation of the prepuce is the notation by Bichat (1801) of the division of the genital nerves into finer branches which lose themselves eventually in the glans penis and the prepuce. Until the description of the genital body and endbulbs in the genital region by Krause and his school, little was added to the knowledge of the area. Krause distinguished the genital bodies from endbulbs by their larger size and by the presence of constrictions on their surface; these bodies were similar in location, nerve supply and form, and basic construction. It is interesting that such definitive work could have been done with only dilute alkali or acetic acid solutions together with the occasional use of Berlin blue.

In 1893 Dogiel published his work on the outer genitalia of man with the methylene blue technic. He found in the inner surface of the prepuce and the frenulum preputii, Meissner corpuscles, genital bodies, and endbulbs. The Meissner corpuscles were more common on the external skin surface. All the statements he made for the prepuce of man were also true for the prepuce of white mouse, rat, and albino rabbit. In the following year Sclavunos (1894) published work on this region with the Golgi method, and he makes no mention of any special endings other than the subepithelial plexuses. He does state that there are peculiar star-shaped cells with branches which penetrate the epidermis in close relation to the nerves of the superficial plexus.

The work of Ohmori (1924) has been the most comprehensive to date, but as in all other cases the data on the prepuce is incidental to information on the rest of the region. He used human material from the 80 mm. embryo through various ages up to 77 years old. In every instance he used only one example of the tissue of each age group. He made use of methylene blue methods and the silver methods of Cajal and Bielschowsky. In an 11.5 cm. embryo he found the earliest appearance of intraepithelial and intercellular nerve fibres. One month after birth he saw Golgi-Mazzoni bodies. In this same specimen he saw little bodies on the outer surface which he did not describe, but called Meissner corpuscles. He described Pacinian corpuscles which were present by the fifth month, and at 10 months he saw what he termed true Meissner corpuscles in the outer skin and nerve balls (Nervenknauel) in the inner surface. In a 5 year old boy he found a typical genital body, and then in a 14 year old boy he found several typical genital bodies. Many of these were adult in type though in general they were small. In 16, 24, 43, 50, 70, 72, 77 year old specimens he observed an increase in size and density of the genital bodies. No diminution occurred with advanced age. It was his conclusion that the chief development of genital bodies is accomplished in postfetal life. He believed the glans penis and prepuce has the same type innervation because they differentiated from the same mass of cells and had basically the same, rich innervation. He mentions finding no Krause endbulbs, and he omits reference to melanocytes.

Bazett and his coworkers (1932) did an interesting piece of work on the sensation of the prepuce and endeavoured to correlate their physiologic findings with anatomical structures. They used the methylene blue technic of Woollard on whole mounts of skin with the subcutaneous tissue cut away. On the basis of their preparations they stated that 7 types of endings existed in the skin of the human prepuce. No statement of the age of the specimens is made, but one may presume on the basis of their physiologic studies that it was adult tissue. The camera lucida drawings they produced and the descriptions they gave do not correspond to classical descriptions of sensory bodies as will be discussed later. They were not able to state with certainty whether intraepithelial endings existed, but they thought on the basis of their depth measurements that they did not exist. In the later communication (1935), these authors stress small nonencapsulated endings as possible receptors for touch, on the basis of the frequency of their appearance.

In an article by F. John (1950) an illustration shows a neurovegetative fibrillar network with neurohormonal cells in the prepuce. No further elaboration of this data with reference to this region has been found.

It is evident therefore that many diverse judgments have been made about this region, and no photomicrographs have been published to support the data obtained. Ohmori states that there are no Krause endbulbs present; Dogiel and Bazett have found them. Ohmori and Dogiel have found genital bodies; they are not mentioned by Bazett. Meissner corpuscles have been found by Dogiel, Ohmori, and Bazett, but the several descriptions do not agree. Ohmori and Dogiel stated that intraepithelial endings existed; Bazett believed they were not present. Melanocytes were not mentioned by any of these authors. The questions these discrepancies raise will be discussed in relation to the present findings.

METHODS

The specimens of normal human, newborn prepuce were slit open, spread flat on cardboard squares, and dropped into 10 per cent formalin or Bouin's fluid immediately after circumcision. From such specimens, sections tangential and vertical to the skin surface were cut at thicknesses ranging from 10 to 100 μ. Several specimens were left intact, and frontal sections were cut from these, allowing observation of the whole external surface of the prepuce at that level. Over 30 specimens were sectioned and examined.

The frozen section method (Winkelmann, 1955a) and the paraffin section method of Bodian (1948) were used concurrently in order to compare and confirm the results. The average thickness of the frozen sections was 50 μ, while no sections thicker than 20 μ were made for the Bodian method. The temperatures of impregnation and reduction were controlled in both silver impregnation methods. All paraffin sections were serial sections.

Several specimens were stained with the Masson trichrome method, the iron alum hematoxylin method, and the Verhoeff elastic stain.

OBSERVATIONS

Nerve networks

In the subcutaneous tissue the major nerve trunks show a great preponderance of myelinated nerve components. There is no tendency for the nerve at this level to form a network. They lie in parallel, wavy courses as may be seen in figure 1. In the center of this figure is a collateral fibre running from one trunk to another. These connecting fibres occur occasionally. The only other type of innervation at this level is the meshwork of fine fibres which surrounds the large vessels. This is in the form of a large network about the adventitia, and shows dividing and ramifying fibres from many directions in the tissue forming a net at the vessel. No specific endings are present. This network about the vessels is present in the lower left hand corner of figure 2.

Nerve fibres of the dermis are arranged into a deeper and a more superficial network. These networks constitute the chief form of innervation of human prepuce of this age. The deeper net is oriented with the rete of arterioles in the reticular layer and may be considered limited to this portion of the dermis. It blends indistinguishably into the more superficial network of nerve fibres which is found in the papillary layer of the dermis. The superficial net extends to a subepidermal position and may lie immediately adjacent to the epidermal cells in its final ramifications. The nerves of the superficial network may enter the papillae along the dermal-epidermal junction or with the blood vessels. The deeper network has the highest proportion of myelinated fibres, in comparison with the superficial network. If one begins deep in the dermis, it is possible to observe the diminution in size of the myelin sheath and its disappearance as the nerve fibres rise in the thick frozen sections. To the left in figure 3 is the wide-spaced meshwork characteristic of the deeper layers, and in the right portion the fine network with smaller meshes and nonmyelinated fibres is visible. Nerves come from several quadrants to run in the same sheath making up the sides of these nerve nets as in figure 4. Both myelinated and nonmyelinated fibres participate in the formation of the networks. Any single area is thus supplied from several directions and by several main nerve trunks.

Changes occur in these networks which may be evidence of degeneration. The myelin sheath disappears abruptly to reappear after a distance. Rough varicosities are present. A more usual observation is the gradual diminution of the myelin sheath not associated with a change in the level of the nerve fibre. It is probable that these changes represent the degeneration which Weddell and Glees (1941) found in nerve fibres of normal skin as a natural occurrence.

In thick sections of the skin it is possible to trace the nerve fibres from deep in the dermis to their ramifications over the rete ridges of the epidermis. The gradual change in diameter of the nerve fibre as it approaches the epidermis may be observed, as well as the ramification of the fibre over the portion of the rete ridge which meets the dermis. The nerve fibres rise to the dermal-epidermal junction from many sources. They appear to mingle at this level, and can be traced no further.

The most superficial nerve nets contain only nonmyelinated fibres, which show irregular, varicose enlargements termed beading. These fibres form irregular

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PLATE I

FIG. 1. × 180. This 50 μ frozen section shows nerve trunks deep in the subcutaneous tissue. Collaterals join two trunks in the center of the photomicrograph.

FIG. 2. × 180. The nerve trunks in this area of a frozen section are at a more superficial higher level than those in Figure 1. In the lower left, net formation is beginning near a large vessel wall.

FIG. 3. × 160. This frozen section shows both types of network formation in the dermis. The deeper network with wide spaced meshes and myelinated and nonmyelinated innervation is to the left, and to the right is the beginning of the more superficial network with small meshes and nonmyelinated nerve fibers.

FIG. 4. × 300. An area of the deeper network in Figure 3 is shown. It shows both myelinated and nonmyelinated nerve fibers running in the same sheath in the sides of the nerve rete. The innervation of any large area comes from several sources and from several directions.

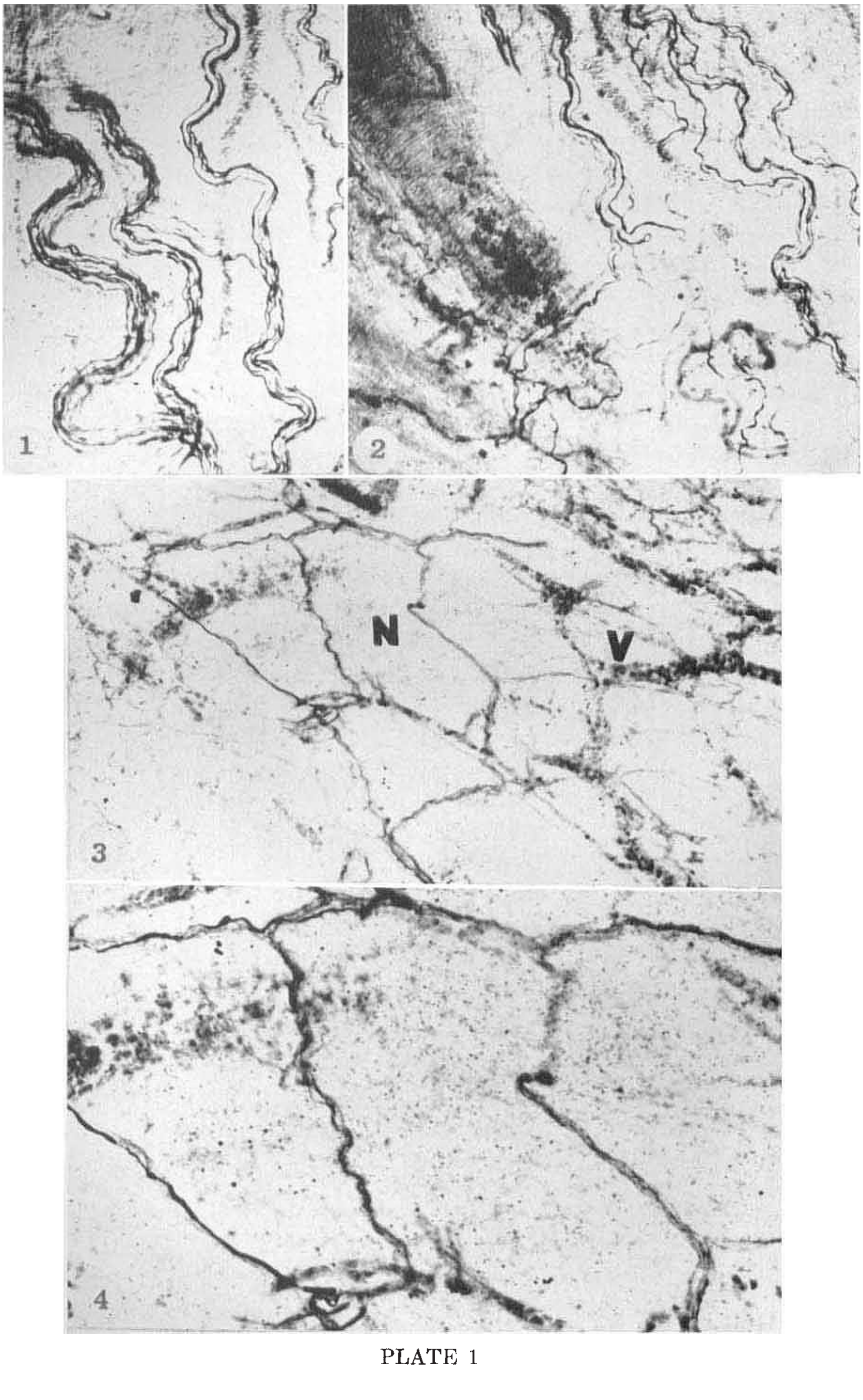

PLATE 1

networks which follow the dermal-epidermal junction as far as it has been possible to trace them. There has been no definite observation which would support the idea of the anastomosis of these fibres into a peripheral continuum as Ruffini (1905) and Wollard (1936b) suggested. The fibres in these final terminal networks may be only one or two epidermal cell diameters apart.

Intraepidermal fibrils. No intraepidermal fibrils could be observed in thick or thin sections cut in either the vertical or horizontal plane and stained with either of the silver methods employed. In no instance have neurofibrils been present in the same plane of focus as epidermal cells. Fine fibres course over the basal cells in close relationship to them as in figure 5. They never pass into the cells of the epidermis or between them. Many times the appearance of nerve fibres within the epidermis has been due to the way in which the section was cut and by the way in which the papillae turn or change the direction of their extension. In such cases, it has always been possible to show by serial section or thick section that the nerve continues on in the papilla, and that the papilla does change form. In figure 6 the confusion between melanocytes and fine nerve fibres in the location is clearly pointed out. There is no question in this preparation as to the dermal continuity of the nerve, and just as clearly the dendrites rise vertically into the epidermis from the exact point where the nerve reaches the dermal-epidermal junction. In figure 7 the course of such a nerve following the rete ridge is shown.

Papillary nerve. In the papillae a variety of nonencapsulated endings ranging from simple loops to complex forms with multiple innervation was observed. In almost all instances evidence of the nerve leaving as well as entering the papillae could be found either in thick frozen section or in serial section. No sign of structural components of a cellular type was found. Beading of the finer fibres occurs as well as rough varicosities in the more complex endings. The simple endings consist only of nonmyelinated nerve fibres while the more complex forms possess myelinated as well as nonmyelinated nerve supply. In all the endings the nerve fibres which compose them are twisted and interlaced with one another, and

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PLATE II

FIG. 5. × 660. A 10μ Bodian section in which the rete ridge is seen from below in a transverse cut of the tissue. The beaded, nonmyelinated nerve fibres forming the network are clear and run over the epidermal cells.

FIG. 6. × 1012. In this 50 μ frozen section a nerve fibre (N) winds up to the rete ridge. One can see that it bifurcates at the epidermis. Its further course is not clear. At that point where the nerve becomes lost to view, the dendrites (D) of the melanocytes begin and extend into the epidermis. Their thick knob-shaped endings and general appearance are distinct from that of nerve structure in this region.

FIG. 7. × 704. A frozen section which shows a nerve winding up to the epidermis and spreading along the base of the rete ridge. There is no sign of extension into the epidermis.

FIG. 8. × 595. Bodian Section. Simple loops near the epidermis.

FIG. 9. × 506. A looping, twisted papillary ending with varicosities in relation to the epidermis.

FIG. 10. × 595. A papillary ending with myelinated and nonmyelinated nerve in the form of a looped and twisted structure.

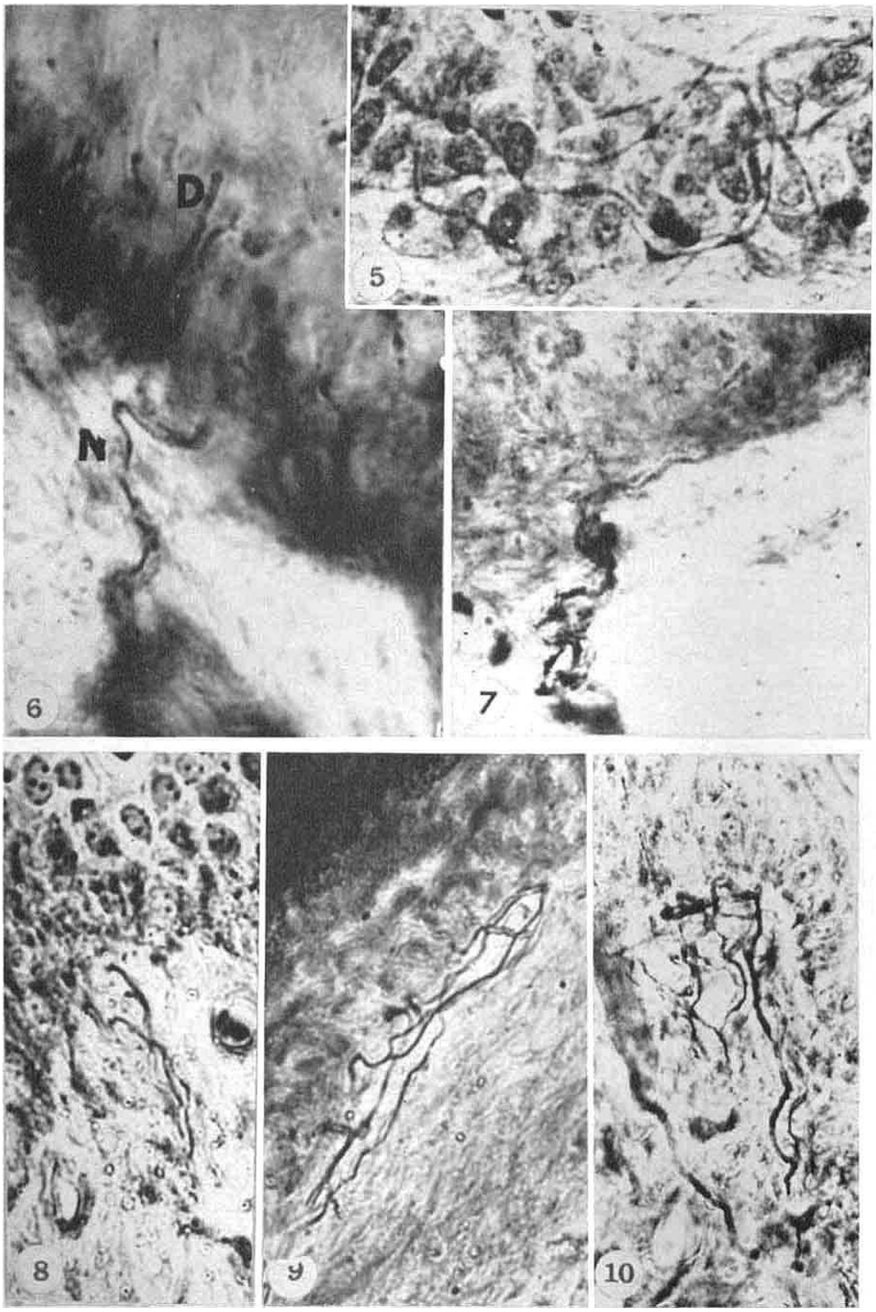

PLATE II

occasionally produce multiple fine divisions which appear at times to show anastomoses. These papillary endings are the only form of organized ending visible in the papillae of the human prepuce of this age. They are not infrequent, but they do not occur with such frequency as to lead one to suppose that they would have a specific function. The range from simple loops to more complex endings is shown in figures 8, 9, and 10. None of the classical bodies of the dermis were observed; that is: the Meissner corpuscle, the Krause endbulb, the Dogiel body, the Golgi-Mazzoni body, and the genital corpuscle. While one would not expect the Ruffini body in the papillae, no evidence of its existence or of the existence of the Golgi-Mazzoni body or the genital corpuscle was found in deeper layers of the dermis and subcutaneous tissue where these bodies have been described.

Vater-Pacinian corpuscle. The only classical ending recognized in the prepuce of the human newborn was the lamellated corpuscle described by Vater and by Pacini. These bodies were frequent in the deeper layers of the skin. Their presence in the deep layers was associated with the large vessels, and the bodies appeared to be in close relationship to them. The body in figure 11, for example, lies in the curve of the large adjacent vessels. In frontal sections of prepuce left intact after circumcision, it was always possible to find one of these bodies somewhere in the circumference of the specimen.

The most remarkable thing about these bodies is their form. In all cases they had an arciform to coiled appearance, although at times they ended in a single long arm. Figure 11 shows a sagittal section through such a Vater-Pacinian corpuscle. At the right is the small convoluted stalk which leads after a winding course into the main section of the body. Figure 12 shows a section cut across the stalk of such a body stained with Verhoeff technique. This shows the cut edges of the tortuous path of entrance of the nerve in the lower left and in the background the lamellar appearance of the normal Pacinian corpuscle cross section into which the stalk finally leads. The appearance of the cut edges of the inner

PLATE III

FIG. 11. × 170. This sagittal section in Bodian prepared tissue shows a common form of the Vater-Pacinian body in the human newborn prepuce. The component parts are clearly visible and include the inner bulb, the lamellated capsule, the nerve fibre and the stalk through which the nerve convolutes to reach the main portion of the body. The stalk is to the right. Note how the body lies in close relation to vessels.

FIG. 12. × 160. This is a vertical section through the coiled stalk of a Vater-Pacinian corpuscle stained with the Verhoeff procedure. The nerve enters at the lower left and follows a twisted path until it enters the main portion of the body. The tortuous pathway has been cut across many times, as is shown by the staining of the inner bulb in the form of circles. In the background are the lamellae of the main portion of the body.

FIG. 13. × 200. This is a section through a Vater-Pacinian body in human newborn prepuce where it is making two right angle turns.

FIG. 14. × 300 This is a photograph of a wax reconstruction of a Vater-Pacinian corpuscle of a human newborn prepuce at 300 diameters. It has an S-shaped contour and the convoluted stalk is at the left end.

FIG. 15. × 200. This is a photograph of a C-shaped Vater-Pacinian body made by the wax reconstruction method. The small stalk here is on the right end.

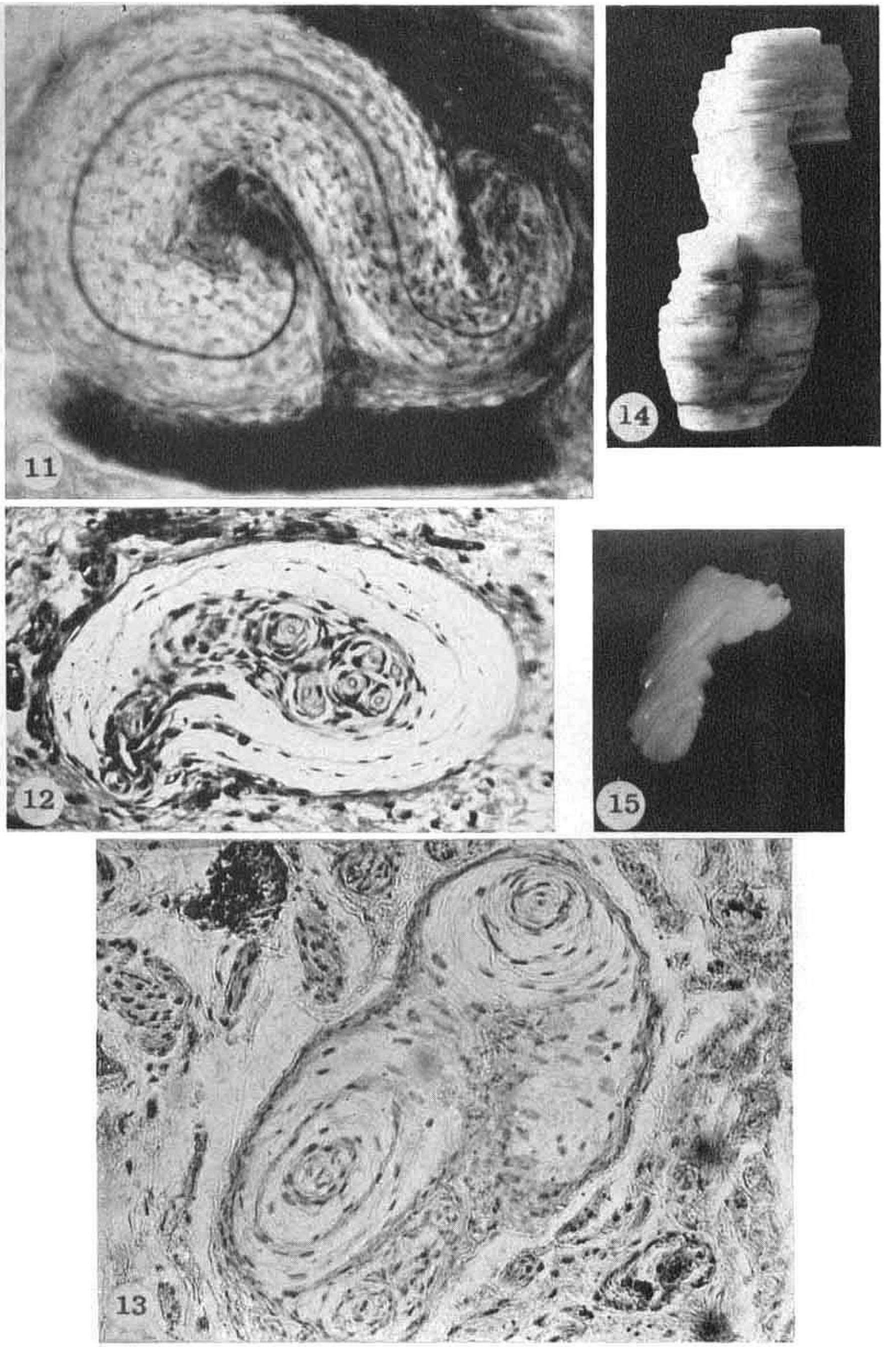

PLATE III

bulb of the stalk is like the cross section of myelinated nerve because of light elastic staining of the inner bulb fibres. No specific elastic structures were found in these bodies. Figure 13 shows a cross section of a Vater-Pacinian body where several right angle turns occur. By the use of serial sections it has been possible to construct wax models of these corpuscles; and two representative bodies are shown in figure 14 and in figure 15. Special connective tissue stains did not produce new data about the composition of the capsule.

The inner nerve fibre was observed in several bodies to be constituted of a number of fibrils all running closely parallel in the inner bulb. Generally, however, in the silver preparations only one solid fibre could be made out. It is notable that no accessory nerve fibres of any type were seen. No terminal enlargements or expansions of the classical descriptions have been noted, but then the form of the bodies described here is quite distinct from the classical, ellipsoid form.

DISCUSSION

The system of nerve networks in the skin has been well described by various authors (Dogiel, 1903; Ruffini, 1905; Woollard, 1935; Woollard et al., 1940; Weddell, 1941). There is no need to elaborate on the descriptions they have given. Demonstration by photomicrograph of these structures in sections prepared by silver impregnation methods is what has been added here. Our work confirms in every respect the beautiful preparations from methylene blue of Woollard, Weddell and their coworkers.

It is obvious that there is overlap in the area supplied by separate nerve fibres. The fact that fibres appear to retain their separate identity at lower levels of the nerve networks is conducive, but not convincing, evidence that this condition is maintained superficially. The final rete of beaded nerve fibres appears to have connections in so many directions it is hard to state anything about it with surety. It was not easy to find the "free" nerve endings of which others speak.

That intraepithelial nerve endings are present in the prepuce from the state of the 11.5 cm embryo onward was stated by Ohmori. We have not found intraepidermal endings in specimens prepared by two selective silver methods. It is possible to show nerve fibres of very fine diameter immediately below the epidermis. Bazett et al (1932) did not find epithelial endings in their methylene blue preparations. Woollard (1936a) concluded from his study that in man such endings are rare. Weddell (1941) and his coworkers have stated that such endings exist and pass at times even to the granular layer, but more recently have stated that nerves pass only in close relation to the epidermis (Hagen *et al.*, 1953). It does not seem probable that intraepithelial fibres exist on the basis of the present evidence.

The present photomicrographs allow one to think that the melanocytes most probably have been confused with nerve terminals. Both Ohmori and Dogiel who described thick and knob-ended intraepithelial nerve fibrils fail to mention the melanocyte. Besides melanocytes, there are other substances as reticulum and elastic fibres which will impregnate selectively with silver treatment. It would be quite easy to confuse structures in this region if one does not use a staining method which is selective enough to allow definitive observation and photography.

The papillary nerve which has been described is similar to that pointed out by Ruffini as "Fiochetti Papillare" or literally papillary floccules (Ruffini, 1905). Dogiel (1903) also described such entities. In the literature are many references to similar end organs which have been termed small Meissner corpuscles and small Krause endbulbs. Actually there is no truly distinguishing feature. This ending resembles the nonencapsulated body described by Bazett *et al* (1935) as serving the function of touch in the prepuce. The simple term, papillary nerve, is a descriptive and accurate one which does not indicate physiologic specificity, and it has therefore been used here. Weddell and his coworkers (1953) have said that there is a gradation of these bodies from simple to more complex, and this work agrees with their description.

No classical nerve endings were observed in the papillary layer of the skin of this region. The specimens may be too young for Meissner corpuscles to be present inasmuch as Ohmori did not find them as typical Meissner corpuscles until the age of 10 months. However, he saw, but did not describe, small bodies he termed Meissner corpuscles one month after birth. In his five months' specimen he does not mention the bodies at all, thus one may believe the time is not well fixed for the development of these bodies. According to Krause (1860) new touch corpuscles do not develop after birth. He found them first in a seven month fetus. Ranvier, however, was of the opinion that they develop chiefly after birth and are well developed by the sixth month (Ranvier, 1880). Dogiel saw typical Meissner corpuscles in adult human prepuce with his methylene blue preparations.

The figure presented by Bazett *et al* (1932) as a Meissner corpuscle is surely not a typical example of such a body. Also, they found these bodies 200 μ below the skin surface, below all the other endings they described. No Meissner corpuscle of typical structure has ever been described out of close relation to a papilla. One is constrained to view the body described by Bazett et al as probably not a Meissner corpuscle. It fits more closely the appearance and location of the genital body which had been described in adult prepuce by both Ohmori and Dogiel.

The genital body was lacking in our preparations. This may well be caused by our limiting the work to one very young age group. That the methods are adequate is evidenced by the illustration of such a body in human adult clitoris (Winkelmann, 1954b) which is comparable to that figured by Ohmori in his article. No trouble should arise in identifying the genital body, since it is unlike any other nerve structure observed to date. It is hoped that further information will be gained from adult tissue.

Ohmori found no Krause endbulbs in any of his specimens, while both Dogiel and Bazett stated that they had seen them. The drawings and descriptions are vague in both the latter instances to allow us to believe that no specific evidence, including our own present data, exists for the presence of these bodies in this area. The Krause endbulb in man may have no distinctive morphology. Workers have great trouble distinguishing this body. It has been described as resembling papillary nerve, the Meissner corpuscle, the genital corpuscle and finally, because of the picture in other mammals, it has been confused with the Golgi-Mazzoni body and the Vater-Pacini corpuscle. Weddell recently doubted his earlier demonstration of this endorgan (Hagen *et al.*, 1952).

The form of the Vater-Pacini corpuscle in this tissue was observed with great interest. The morphology did not agree with the description in any current texts, and only on extensive search of the literature was it found that a varied external form had been recognized, chiefly by Krause (1860), but also by Sala (1899) and Dogiel (1903). The type 5 body of Bazett *et al* (1932) resembles this structure. No emphasis has been placed upon the arched external form of the Vater-Pacini corpuscle, and it was observed with surprise that this was the chief form of the body in the prepuce of this age. It is apparent in our material that all the bodies present have coiled or serpentine form that is best explained by continued growth in a limited space. The coils occur in relationship to large vessels. Such a form lends itself admirably to the perception of changes in pressure and tension in the tissue, as the coils are oriented in three dimensions. In 110 mm. and 140 mm. human embryos it has been possible to see similar coiled bodies in the finger tip. A study of wax reconstructions of the bodies of the finger tip of man has been made to show the morphologic variation of the body (Winkelmann and Osment, 1955).

In Ohmori's work are presented several drawings which are labeled Golgi-Mazzoni bodies. These are identical with figure 15 which shows a section of the coiled stalk through which the nerve passes to reach the main portion of the Vater-Pacinian body. Lack of emphasis upon the stalk of the Vater-Pacinian body and its other external features has led to such confusion. Transitional forms between the Golgi-Mazzoni bodies and the Vater–Pacinian body have been described, and the present study seems to indicate that these structures as well as the Golgi-Mazzoni bodies of Ohmori are Vater-Pacinian bodies alone. This raises the question as to whether the Golgi-Mazzoni body exists outside of the tendon, the site of its original description. No Golgi-Mazzoni bodies which accord with the original description were found in the newborn prepuce.

The results of this work show that in the newborn prepuce there exist three types of endings: the nerve nets, the papillary nerve, and the Vater-Pacinian body. The nerve nets and the papillary nerve contain the same components, and they differ only in the location in which they have developed. The nerve nets developed unhindered in the dermis, while the papillary nerve developed in a confined space which forced the elements into a close association. The prepuce is chiefly a glabrous region, and only in the glabrous regions have special papillary structures been described. This indicates that the nerves, which elsewhere would surround hair follicles, developed close to the surface epithelium to form the structures found in the lip, palm, finger, and genital skin and prepuce.

Our findings correspond with those of Weddell and his group, if we consider our papillary nerve as a form of "organized" ending. They found only two types of endings in hairy skin; free nerve nets, and endings about hair follicles; and only two types in glabrous skin: free nerve nets and "organized" endings. They do not mention the Vater-Pacinian body in their work. They stated that the "organized" endings possessed a nonspecificity of structure similar to that ascribed here to the papillary nerve. On the basis of the present and prior work, it seems advisable to broaden the term "organized" endings to include the Meissner corpuscles, the genital body and the Vater-Pacinian corpuscle. All of these have a specific structure that must be considered in an analysis of the sensory endings.

In physiologic studies based upon the morphology of the innervation described in the work of Weddell and his colleagues a peculiar lack of correlation between structure and function was shown. On the basis of this work, they felt the theory of Von Frey, that specific function was served by specific structure, needed to be reevaluated. The questions raised about the morphologic work on the prepuce indicates that work of Bazett and his group on the prepuce should also be confirmed.

Since only one young age group has been studied, there is much to be done to elaborate further the morphology of the sensory innervation of the prepuce. Earlier age groups should be studied to watch the development of the papillary nerve from the dermis. It is necessary that a study of pubescent and adult tissues be done to confirm Ohmori's group of isolated findings about these age groups and the development of organized endings. The afferent nerve supply of this area must be known before physiology can be correlated with the nerve anatomy of this region.

SUMMARY AND CONCLUSIONS

1. The principal form of innervation of human newborn prepuce consists of a deep and superficial network of nerve fibres in the dermis.
2. Nonencapsulated papillary endings were observed ranging from simple loops to more complex endings, but differing in no essential constituent from the networks of the dermis.
3. Dendrites of melanocytes were observed but no intraepithelial nerve terminals were noted.
4. Except for the Vater-Pacinian corpuscle, none of the classical sensory corpuscles were seen in this tissue. No Meissner corpuscles, Golgi-Mazzoni bodies, genital bodies, Krause endbulbs, or Ruffini bodies were observed, and these findings have been discussed in the light of the conflicting literature on this subject
5. The chief form of the Vater-Pacinian corpuscle in this tissue is coiled and differs markedly from the usual textbook descriptions of this body. The stalk of this corpuscle has not been sufficiently emphasized and has been confused with the Golgi-Mazzoni body.

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